

## COLLAPSE BEHAVIOR OF RED SOILS OF SILTY SAND NATURE BASED ON ENGINEERING PROPERTIES

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### ABSTRACT

*Red soils are subjected to rapid changes in their volume when saturated with water. These soils show relatively high apparent strength in their dry state, but have low density, Porous structure is-susceptible to large deformation upon wetting due to the sudden large reduction in their volume with or without additional loading, Several methods have been used for understanding the behavior of collapsible soils. The method selected is understanding the geotechnical properties of Red Soils which causes collapsibility. In the present study grain size distribution, consistency, compaction characteristics and aided properties are considered for analysis of collapsible behavior of red soils.*

**KEYWORDS:** Red Soil, Collapsible Behavior & Geotechnical Characteristics

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### INTRODUCTION

Geotechnical Engineers have been facing settlement problems when structures are founded on red soils. Vishakhapatnam region is familiar with red soils which are collapsible in nature. Roads, Building, Retaining wall founded on these soils subjected to settlements due to the decrease in the volume of red soils upon saturation. To avoid distress when structures are found on these soils require a complete understanding of the engineering behavior of soils. In this, an attempt is made in studying physical and geotechnical Characterisation of these soils with respect to their collapsible behavior.

In the present analysis 10, red soils in Vishakhapatnam Region from north coastal districts of Andhra Pradesh were collected and tested for their geotechnical characterization. Based on these values, their collapsibility in geotechnical applications has been verified.

Some of the earlier studies on collapsible behavior are listed below Mitchell & Soga (2005), Pereira (2000), Holden Hiff (1961), Rogers(1994), Clemense & Finbar (1981), Latun (1992) etcare extensively studied on collapsible soils.

### MATERIALS

To study the geotechnical characterization of red soils in Visakhapatnam region, the soil samples were collected at a depth of 1.0 – 1.5m from the ground level and the collected samples were dried and subjected for

geotechnical characteristics such as grain size distribution, plasticity, compaction and strength as per IS 2720.

## TESTS & RESULTS

To explain collapsibility behaviour of red soils parameters like porosity, Void ratio, degree of saturation and dry densities are considered in the dry side of compaction along with the index and engineering properties and these are shown in table:

**Table 1: Geotechnical Properties of Red Soil**

Location/Property	SM - I	SM - II	SM - III	SM - IV	SM - V	SM - VI	SM - VII	SM - VIII	SM - IX	SM - X
<b>Gradation Properties</b>										
Gravel (%)	0	0	0	0	0	0	0	0	0	0
Sand (%)	85	80	76	82	74	78	76	75	80	82
Fines (%)	15	20	24	18	26	22	24	25	20	18
Silt (%)	15	17	20	16	21	19	20	19	14	14
Clay (%)	0	3	4	2	5	3	4	5	6	4
<b>Index Properties</b>										
Liquid Limit (%)	21	22	23	22	23	22	22	22	23	22
Plastic Limit (%)	18	18	19	18	19	19	18	18	19	18.5
Plasticity Index ( $I_p$ )	3	4	4	4	4	3	4	4	4	3.5
IS Classification	SM	SM	SM	SM	SM	SM	SM	SM	SM	SM
<b>Compaction Characteristics</b>										
(OMC %)	9.2	9.0	9.4	9.0	8.8	9.3	9.2	9.0	9.5	9.1
(MDD g/cc)	1.74	1.75	1.77	1.75	1.68	1.72	1.73	1.70	1.76	1.71
<b>Ranges</b>										
$\gamma_d$ to $\gamma_d$ Max.	1.51 – 1.74	1.49 – 1.75	1.50 – 1.77	1.50 – 1.75	1.45 – 1.68	1.72 – 1.47	1.48 – 1.73	1.44 – 1.70	1.47 – 1.76	1.48 – 1.71
Void Ratio	0.76-0.52	0.78 – 0.52	0.77 – 0.50	0.77 – 0.51	0.83 – 0.58	0.79 – 0.54	0.79 – 0.53	0.84 – 0.55	0.81 – 0.51	0.79 – 0.54
Porosity	43.2-34.2	43.8 – 34.2	43.5 – 33.3	43.5 – 34.2	45.4 – 36.7	44.1 – 35.1	44.1 – 34.6	45.65 – 35.48	44.8 – 33.8	44 – 35
Degree of Saturation	12.60 – 46.90	10.9 – 45.9	11.01 – 19.8	10.33 – 45.9	10.22 – 40.2	11.4 – 45.6	12.8 – 46	9.46 – 43.36	13.14 – 49.6	9.7 – 44.65

## DISCUSSIONS

### Geo-Morphological Identification

- These are well drained, wind-blown, hill washers of loose consistency with Mechanical and chemical weathered materials of Khondolite rock mass.
- These are also residual soils. These soils are dominated by fine sand particles followed by silt particles and these are coated with small amounts of clay particles at their point of contact. Hence these are characterized by loose structure, (Honey Combed) with bulky shaped grains dominated with fine sand and silt particles with a small number of clay particles.

**Based on Engineering Properties of Red Soils the following Identifications are Made**

- Based on the test results of 10 number of soils are dominated by sand size particles with less number of fines out of which the percentage of clay particles is very minimum.
- These are exhibiting very low compressibility and plasticity characterizes with the liquid limit is ranging from 21 – 23% and plasticity Index from 3-4. Based on IS 1498-1970 these are classified under SM. Absence decreases in volume on saturation are due to the absence and soften of clay bond between sand grains.
- These deposits are ranging from 2 to 5 m thick with a high void ratio of 0.84-0.76, porosity 43.2- 45.65, low dry densities in the range of 1.44-1.72 g/cc and degree of saturation 9.46 – 13.14%.

**Based on the above Characterizes of Red Soils the following Identifications are Made**

- Red soils compacted at their dry densities less than their maximum dry densities and water content less than their optimum moisture content will exhibit high Collapsibility. At these conditions, the soils occupy loose structure with high quantities of air voids by maintaining with high porosities. Soils compacted at dry state are deficient in moisture exhibit hard in consistency with high void ratios and less degree of saturation. Under saturation the water replaces the airspace and soil particles come together by the loss of their honeycombing structure. This phenomenon is similar to the statement of Tadepalli and Fredlund (1991) and Ayadat (2007), Reznik (2007).

**CONCLUSIONS**

Considering the test results of red soils the following conclusions are drawn:

- Soil compacted at low dry densities and low water content will exhibit a high degree of collapsibility.
- Saturation destroys the bond between sand particles by dissolving clay particles and salts of oxides leads to increases the collapsible behavior.
- Soils compacted at dry densities nearing to max dry densities and water content just above optimum moisture contents will be free from collapsible behavior.

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